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(*From the American Naturalist, May, 1884.*)

Ayers' Development of Œcanthus niveus and its Parasite Teleas.—This is an extended, thorough, and well illustrated memoir on the embryology of the tree cricket, and its egg parasite, by Howard Ayers, a student of Professor E. L. Mark, at Cambridge, Mass. It received the Walker prize of the Boston Society of Natural History, in whose memoirs it appears, under date of January, 1884, forming a brochure of 56 pages, with eight plates and woodcuts in the text. Mr. Ayers endeavors to establish the following points in the embryology of Œcanthus:

1. The origin of the ovum in a germarium rather than from an ovarian epithelium.
2. The process of yolk formation by cell-degeneration instead of secretion.
3. The occurrence of a primitive segmentation of the embryo before the appearance of the permanent segments.
4. The existence of a pair of appendages (some of them rudimentary [deciduous]) on each of the seventeen segments of the body.
5. The origin of the dorsal vessel as a paired organ, the lateral halves of which fuse and give rise to a median tube in the same

manner as in some of the worms, and the origin of the blood corpuscles as nucleoli of endodermic cells.

6. The existence of embryonic gills.

7. The lack of any sharp distinction between a cell and its nucleus, and between a nucleus and its nucleolus.

8. The existence of segmental enlargements of the mesodermic somites, similar to those from which the nephridia of worms take their origin.

9. The origin and significance of the embryonal membranes among the insecta.

10. The origin and significance of the dorsal organ among the insecta.

Among the chief points of interest is the mode of formation of the blastoderm. No nucleus was observed in the fertilized eggs, even in those which had been only laid from one to twenty-five minutes; and in the ovarian egg after the disappearance of the germinative vesicle no traces of nuclei were to be found. When the blastoderm is partially formed, however, there are always numerous amœboid cells to be found throughout the yolk. These nuclei form the blastoderm in the following manner: the pseudopod-like processes sent out by a few of those migrating to the surface of the yolk fuse together, and furnish by rapid division a sufficient number of cells to form the blastodermic membrane. This mode is the same as observed by Bobretsky in the Lepidoptera. There is no segmentation of the yolk.

The fact that at first the embryo is composed of four well-marked regions, which the author designates as the "cephalic, maxillary, thoracic, and abdominal," is interesting. The author does not attempt to compare this feature with the earliest stage of the spider with its protozonites, as discovered by Claparede, but the resemblance is at least a striking one.

The process of turning of the embryo is clearly described and figured. After giving a summary of the development, attention is next directed to the mode of formation of the different organs. The novel points worked out are the origin of the heart and the discovery of so-called gills, and the relations of the germinal layers.

The formation of the heart begins after the revolution of the embryo; it is first to be distinguished in the abdominal region about the time of the closure of the dorsal ectoderm. "In the formation of the heart, the lateral plates of mesoderm grow upward around the mesenteron, and as their edges approach the median dorsal line there is seen to be in each a tube. These two plates coalesce in the median line, and their tubes unite into one—the heart, or dorsal vessel."

The discovery of the "gills or respiratory organs" which Mr. Ayers describes is rather startling. A pair of lateral outgrowths arise from the ectoderm of the pleural region of the first abdominal segment, and "come to lie just behind but dorsad of the base of the third thoracic appendage." The internal cavities of each gill "are continuous with the body-cavity, and probably serve as channels through which the vascular fluid circulates." In sections of the gill-organ before becoming atrophied or absorbed, both distinct canals and lacunar spaces radiate from the point of connection of the pad with the body; "and these, together with the arrangement of the cells, give the radiate structure characteristic of the fresh gill." "The gill pad is essentially a single-layered sac, with a much constricted neck, evaginated from the pleural region of the abdomen." It should be observed that these are not tracheate gills, as they contain no tracheæ. Mr. Ayres does not speculate as to their origin.

While not accepting Balfour's interpretations and general conclusions as to the origin and significance of the primitive germinal layers among the insecta, Mr. Ayers confesses himself still in doubt as to their origin. But, he adds, "when we consider the rôle and subsequent fate of these two layers, it at once becomes apparent that such a view does not accord with the facts, for the blastoderm ultimately forms the entoderm (mesenteron), and the ectoderm, arising from a small area of thickened cells on one side of the blastoderm, encloses the yolk and endoderm by a genuine epiboly." With some hesitancy he then proposes an explanation which may apply to the Orthoptera: "How did the embryonic membranes (amnion and serosa) arise? What is their function? Is their present function the primitive one? The answer to these inquiries undoubtedly lies in the clear comprehension of the relations of the embryo to its food supply—the yolk. That the cellular embryonic membranes could have originated for protection, or from an early ecdysis, is, to say the least, highly improbable. Among the insecta the egg is furnished with a *protective membrane*—usually in the form of a chorion—before leaving the body of the parent. Omitting the interesting and original explanation in full, the result is that "in Œcanthus the membranes fuse at or near the head, and by a self-eversion through the opening caused by their rupture the embryo comes to lie outside of the amnion and serosa. The latter now forms a yolk sac, which, by a gradual contraction, as the yolk is absorbed, comes to lie within the body, being last seen just back of the head. It is always in connection with the mesenteron, and its thick walls finally disappear by a process of disintegration." The author thinks that in many, if not all, insects, the serosa and amnion play the same rôle that they do in Œcanthus, *i. e.*, "the serosa functions as a yolk sac, while the amnion is the dorsal wall of the insect. Hence the so-called dorsal organ is but the remnant of the yolk sac."

It is interesting to compare the history and function of the serosa and amnion in two branchiate Arthropoda (Limulus and Apus), in which, Limulus at least, the serosa does actually become what we have called a "vicarious chorion," and after the chorion or egg-shell splits, becomes a protective membrane.[1]

Mr. Ayers' observations on the egg-parasite, Teleas, are full and valuable, showing, as he claims, the absence of embryonic membranes, and the occurrence of a larval form intermediate between the blastosphere and the cyclops larva of Ganin.

The illustrations are admirably clear, but the plates are too much crowded; this, however, is not the fault of the author.

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[1] See The Development of Limulus polyphemus. By A. S. Packard, Jr. Mem. Bost. Soc. Nat. Hist., March, 1872, p. 160, 161.

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